Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

FAMILIES OF AMERICAN MEN OF SCIENCE

By Professor J. McKEEN CATTELL

COLUMBIA UNIVERSITY

III. VITAL STATISTICS AND THE COMPOSITION OF FAMILIES

IT has been claimed that children of older parents are physically and mentally inferior. Conversely, C. L. Redfield in a curious book entitled "Control of Heredity" and in various articles argues that men of distinction are likely to be born when their fathers are old and that their performance is due to inheritance of the experiences gained by their fathers. If the age of the parents affects the constitution of the children, this clearly is a matter of importance, particularly if the principles of eugenics are enforced either by law or by sentiment. But at present we have no scientific information on a problem which could be solved by statistical research.

The fathers of 865 leading American men of science were on the average 35 years old and their mothers were 29 years and 8 months old when their sons were born. The fathers married at the average age of twenty-eight years, being somewhat more than five years older than their wives. The scientific men are consequently born at an average interval of seven years after the marriage of their parents. The ages are given separately for the four groups into which the scientific men have been divided and are earlier for both fathers and mothers (group I. in the table) of those more distinguished. The probable errors given in italics show that the differences may be due to chance, but that this is unlikely. It is the case, as shown

TABLE XII. THE AGES OF THE PARENTS AT THE BIRTH OF THE SCIENTIFIC MEN AND AT DEATH, ACCORDING TO THE STANDING OF THEIR SONS

	No.	Age at Birth of Scientific Man		No.	Age at Death	
		Father	Mother		Father	Mother
I.	64	34.02 ± *.57*	28.37 ± *.50*	62	70.18 ± *1.12*	70.89 ± *1.36*
II.	160	34.54 ± *.40*	29.86 ± *.31*	154	70.85 ± *.75*	70.68 ± *.78*
III.	505	35.00 ± *.23*	29.72 ± *.20*	496	70.77 ± *.38*	69.96 ± *.36*
IV.	136	35.69 ± *.53*	30.09 ± *.38*	121	70.91 ± *.92*	69.45 ± *.99*
Total	**865**	**34.95** ± *.18*	**29.70** ± *.15*	**833**	**70.64** ± *.30*	**70.20** ± *.31*

below in Table XIV., that the first-born son is the one most likely to become a scientific man, and the parents of first-born children are of course younger.

In Table XI. is also given the average age at death of the parents, whence it appears that the fathers died at the average age of 70.6 years, the mothers at 70.2 years, the chances being even that these figures are correct within a third of a year. The average age of the scientific men being about fifty years, most of their parents are no longer living. If, however, the deceased parents only had been included, the averages would have been too low, as the more long-lived parents would be those more likely to be living. The expectation of life has been added to the age of each of those still living, and the probable age at death used in the averages. The ages given do not mean that people of this class live to those ages, or that the men live longer than the women. A statistical error such as this has often been made, a distinguished scientific man having, for example, urged that it is one of the advantages of the scientific career that scientific men live much longer than the average, failing to note the circumstance that there are no scientific men who die when they are babies. The figures in the table mean that the fathers being on the average 35 years old when their sons are born have an expectation of life of 35.6 years, and will on the average die at the age of 70.6 years. The mothers, averaging 29.7 years old, have an expectation of life of 40.5 years. These expectations are about four years longer than those allowed by standard mortality tables, but the data are not exactly comparable. Although the parents of the more distinguished scientific men do not live longer than the others, they live longer after the births of their sons.

TABLE XII. THE AGES AT DEATH OF THE FATHERS OF THE SCIENTIFIC MEN IN ACCORDANCE WITH THEIR OCCUPATIONS

	No.	Age at Death
Professions....	370	69.67 ± *.45*
Clergymen	94	71.68 ± *.81*
Physicians	66	67.20 ± *1.08*
Lawyers ...	57	71.75 ± *1.19*
Teachers...	70	69.29 ± *1.07*
Other........	83	68.25 ± *.92*
Agriculture...	193	72.81 ± *.62*
Manufacture	330	70.65 ± *.48*
Total..	**893**	**70.71** ± *.29*

Table XII. shows that the farmers who were fathers of scientific men died at the average age of 72.8 years, the physicians at 67.2 years, a difference of over five years between the shortest and longest lived of the groups. The clergymen and lawyers lived one year less than the farmers, the teachers two and a half years less. Those engaged in manufacturing and trade died at the average age. According to the report of the English registrar-general (1908), the death rates per thousand during the years 1900–1902 for those between 45 and 65 in different occupations were: Farmers, 14.8; clergymen, 15.5; teachers, 15.8; lawyers, 18.3; physicians, 23.9.

Table XIII. gives the ages at death of the mothers in accordance with the size of their families. The crude figures are subject to a statistical error, as mothers might have small families because they died early. This is eliminated by considering only those who survived the child-bearing age. In this case mothers of one child died at the average age of 68.6 years; mothers of 12 children at the age of 80.6. There are included 759 families, but the number of families of different sizes is too small to give entirely valid averages. Still it is significant that the thirteen mothers of 11 and 12 children lived to the average age of 78 years; the 43 mothers of 9 and 10 children to the age of 75 years. It is probable that the women who were the more vigorous had the largest number of children and also lived to the greatest age; they might have lived as long or even longer if they had been unmarried. Though largely due to statistical selection, the fact remains that of 45 mothers of one child 10 did not survive the age of 45, whereas of 56 mothers of from 9 to 12 children not one died under this age. In view of these facts it may be doubted whether the practise of limiting the number of children is beneficial to the health and longevity of the mother.

TABLE XIII. AGE AT DEATH OF MOTHERS OF THE SCIENTIFIC MEN IN ACCORDANCE WITH THE SIZES OF THEIR FAMILIES

Size of Family	1	2	3	4	5	6	7	8	9	10	11	12	Av.
Number........	45	91	106	136	110	112	59	44	27	16	8	5	**759**
Age at death..	61.7	67.9	69.3	71.7	69.1	71.5	73	70.7	77.6	70.5	76.2	80.6	**70.1**
No. dying under 45.......	10	17	11	10	11	3	2	4	0	0	0	0	**68**
Age at death of those surviving 45...	68.6	74.2	73	74.4	72.5	72.5	74	73.6	77.6	70.5	76.2	80.6	**73.3**

Table XIV. gives the numbers of scientific men who were first-born children, second-born, etc., for each size of family. A scientific man is of course more likely to be a first-born child than a second-born, because there are families with only one child and consequently more first-born children. But it appears from the table that the first-born child is more likely than the others to become a scientific man. In families of two or more children, 285 are first-born and only 168 second-born; in families of three or more, 214 are first-born and 114 third-born; in families of four or more, 159 are first-born and 81 fourth-born.

The first-born child has been reported to be more likely to be a man of genius, an idiot, a consumptive and various other things, but usually as the result of some statistical fallacy. If, for example, in our figures only families of two and eight are considered, there being on the average five children and two first-born, it looks at first sight as though the chances are one in five that an individual selected at random would be the first-born. But both families being represented, it has been argued that the chances are half that the individual is the first-born in the small family and one eighth in the large family, or on the average five sixteenths, nearly one in three. However, the family of eight is four times as likely to be represented in a random selection from the two families, so the chances of the individual being first-born are reduced to one in five. Finally—and this seems to have been overlooked—there are three times as many families of two as of eight, and there are in fact 16 chances out of 61, or a little over one in four, that the individual selected at random will be the first-born.

TABLE XIV. THE ORDER OF BIRTH OF SCIENTIFIC BORN

	Order of Birth												
	1	2	3	4	5	6	7	8	9	10	11	12	
1	63												**63**
2	70	52											**122**
3	55	39	31										**125**
4	53	33	32	29									**147**
5	47	13	18	17	23								**118**
6	30	17	16	19	21	14							**117**
7	16	7	8	7	9	14	7						**68**
8	7	3	5	4	8	5	4	8					**44**
9	5	1	2	4	4	4	0	3	5				**28**
10	1	1	2	0	1	2	0	0	0	5			**12**
11	0	1	0	1	0	1	0	0	1	1	1		**6**
12	0	1	0	0	0	0	0	1	0	1	1	1	**5**
	347	168	114	81	66	40	11	12	6	7	2	1	**855**

These errors have been eliminated by the method used in the table, but there are at least two other statistical errors that affect such data. When we are dealing with contemporary families the older children may be preferred. Thus children under fifteen are not likely to suffer from pulmonary tuberculosis or to be criminals, and the patient or the prisoner may be more likely to be the first-born child than the last born. This circumstance holds for the scientific men. They are on the average 38 years old when they attain their position, and the scientific population is rapidly increasing, so the earlier born children are more likely to be included. This factor, however, is small, as is shown by the fact that the second-born child is not appreciably more likely to be a scientific man than those later born. Probably a larger statistical error is introduced by the fact that a man sometimes does not know of or ignores children who were born and died before he himself was born, and thus records himself as the first-born.

In so far as it may in fact be the case that the first-born child is more likely to be a scientific man, this is probably due to social rather than to physiological causes. Galton found the eldest son to be preferred, and perhaps this might be expected under a system of primogeniture. In this country where families are apt to improve their economic condition, the younger sons may be more likely to be sent to college than the older, but as to this there is no available information.

In Table XV. the intervals are given between marriage and the birth of the first child and between the births of successive children for families of different sizes. When there is only one child it is born on the average 3.2 years after marriage, whereas in a family of five or more the interval is about a year and a half. In the standardized family of two the second child is born 4.2 years after the first, twice as long as for large families. The delay in the birth of children in small families might be due to the same physiological or pathological causes which make the family small, but in most cases it is probably due to voluntary control.

TABLE XV. INTERVALS IN YEARS BETWEEN MARRIAGE AND BIRTH OF FIRST CHILD AND BETWEEN BIRTHS OF SUCCESSIVE CHILDREN

Size of Family	No.	1	2	3	4	5	6	7	8	9	Av.
1	70	3.17									**3.17**
2	121	2.14	4.21								**3.17**
3	120	1.87	3.09	4.00							**2.99**
4	56	1.59	2.40	3.16	3.82						**2.74**
5	29	1.62	2.52	2.69	3.38	3.76					**2.79**
6	12	1.33	1.83	2.00	2.92	2.25	2.75				**2.18**
7	5	1.40	2.00	1.60	2.60	3.00	2.00	2.20			**2.11**
8	2	2.00	1.50	2.50	2.00	2.00	2.00	2.00	3.50		**2.19**
9	1	1.00	2.00	1.00	2.00	2.00	1.00	3.00	2.00	2.00	**1.78**

From Table XVI. it appears that 478 scientific men had 716 sons and 660 daughters. This difference falls within the limits of chance variation, and is not likely to be significant. In the families from which 832 scientific men come there were 2,537 sons and 1,527 daughters. This disparity may at first strike the reader as inexplicable. Galton in his "Hereditary Genius" says: "I also found the (adult) families to consist on an average of not less than 2½ sons and 2½ daughters each. Consequently each judge has on an average of 1½ brothers and 2½ sisters. . . . 100 judges are supposed to have 150 brothers and 250 sisters." Nearly all those whom I have questioned about this statement think that it is correct. It seems to most people obvious that if there are equal numbers of boys and girls, a boy must on the average have one more sister than brother. As a matter of fact, however, a judge, a man of science or any other man, is likely to have not fewer but more brothers than sisters. 832 scientific men had 1,705 brothers and 1,527 sisters. Havelock Ellis finds 121 boys and 100 girls in the families producing British men of genius, and concludes that they "are the offspring of predominantly boy-producing parents"; this curious fact is further emphasized by the fact that families yielding women of genius "show a predominantly girl-producing tendency." A boy has as many brothers as sisters, owing to the sex composition of families. Thus in families of two, one fourth of the families will consist of two boys, one fourth of two girls and one half of a boy and a girl. On the average, four boys will have among them two brothers and two sisters, and there is a similar equality for larger families. A man is likely to have more brothers than sisters for the same statistical reason that he is likely to come from a larger family than he has. If a family consists of six boys, it is six times as likely to produce a judge as a family consisting of one boy and five girls. The judge or the scientific man is thus likely to have more brothers than sisters.

TABLE XVI. DISTRIBUTION OF SONS AND DAUGHTERS

Size of Family	No. of Families	Family of Parents		
		Sibs	Sisters	Brothers
(1)				
2	126	126	69	57
3	128	256	123	133
4	152	456	244	212
5	125	500	266	234
6	123	615	327	288
7	71	426	235	191
8	48	336	172	164
9	31	248	121	127
10	16	144	83	61
11	7	70	34	36
12	5	55	31	24
Total	**832**	**3232**	**1705**	**1527**
		Family of Scientific Men		
		Children	Sons	Daughters
1	81	81	42	39
2	136	272	153	119
3	130	390	199	191
4	63	252	130	122
5	41	205	104	101
6	15	90	46	44
7	5	35	16	19
8	4	32	10	22
9	3	27	16	11
Total	**478**	**1384**	**716**	**668**

Table XVII. contains information in regard to deaths in the families of scientific men. For their brothers and sisters the percentage of deaths recorded under five years is 14.8, and under twenty-five years it is 22.5. For their children the percentages are 7.5 and 10.9. The death rate has thus decreased to half in a single generation, and for the children of the scientific men is probably the smallest known. As only completed families are considered, there are practically no children under five, but those under twenty-five who might die before reaching that age make the death rate too low in this group. It is difficult to see how more valid statistics can be obtained than those supplied by scientific men, the order of birth and the dates of birth and death having been given; yet it is undoubtedly the case that all deaths are not recorded, especially for the brothers and sisters who died in infancy. This error would, however, only emphasize the decrease in the deaths of the children as compared with the preceding generation. The number of deaths among a thousand children born is not directly comparable with death rates per thousand of the child population. When there are seventy-five deaths under the age of five among a thousand infants born to the scientific men, the annual death rate is somewhat larger than 15.

TABLE XVII. DEATHS IN THE FAMILIES OF SCIENTIFIC MEN

	Size of Family Brothers and Sisters		Tot. or Av.
	1 to 6	7 to 12	
Number of families	515	129	**644**
Brothers and sisters	1406	917	**2323**
% of deaths under 5	14.22	15.59	**14.77**
% of deaths under 25	22.28	22.63	**22.51**
	Children		
	1 to 4	5 to 9	
Number of families	416	67	**483**
Children	1024	381	**1405**
% of deaths under 5	7.37	8.01	**7.54**
% of deaths under 25	10.69	11.55	**10.93**

The decrease in the infantile death rate in recent years is so remarkable as to be almost incredible, and the existing differences in nations and social classes are appalling. In the families from which our scientific men come, the death rate for children under five is somewhat over 30 and in their own families it is somewhat over 15. The rate in the registration area of the United States in 1900 was 51.9. In the present registration area it was 32.9 in 1911, varying from 41.1 in Massachusetts to 18.6 in Washington, from 74 in Fall River to 22.4 in Seattle. In or about 1900, the rates for other nations were:

Russia	134.5
Spain	104.1
Austria	86.7
Germany	74.2
Italy	74.8
England	53.5
France	47.6
Sweden	37.5
New Zealand	23.2

The table indicates a small selective death rate against the larger families. When there were one to six brothers or sisters the percentage of deaths under five years was 14.2 as compared with 15.6 for larger families; when the number of children was four or less, the percentage was 7.4 as compared with 8 for families of five or larger. This small difference is probably due to the coinciding decrease in the birth rate and in the death rate. The larger families had a higher death rate not because they were larger but because they were earlier when the death rate was higher. Other statistics, such as those of Rubin and Westergaard for Copenhagen, show a selective death rate against the larger families. In the statistics with which we are concerned poverty and neglect are almost excluded.

In Table XVIII. is shown the relation between the size of the family from which the scientific men come and the size of the family that they have, the scientific men being divided into three age groups. It will be noted that the size of family of the scientific men varies with their age at the time, being 2.7 children when they are above 59; 2.3 when they are between 50 and 59, and 1.9 when they are under 50. These differences are partly due to statistical selection, the families of the younger men being not absolutely complete, and the barren and smaller families being more likely to be included. They, however, in part represent the declining birth rate within a period of twenty years. There is shown a slight positive correlation between the number of brothers and sisters and the number of children. Thus when a man comes from a family of 1, 2 or 3 children, his family averages 2.1, and as the size of the family from which he comes increases by groups of three, his own family increases to 2.2, 2.3 and 2.8. The probable errors show that the figures have a limited validity. The differences, how-

TABLE XVIII. THE RELATION BETWEEN THE SIZES OF FAMILIES OF THE PARENTS OF SCIENTIFIC MEN AND THE SIZES OF THEIR OWN FAMILIES

	Size of Parents Families				Tot. or Av.
	1, 2, 3	4, 5, 6	7, 8, 9	10, 11, 12	
Under 50.	94	110	37	12	**253**
Size of family	1.69	1.99	1.81	2.41	**1.88**
50–59	74	93	33	5	**205**
Size of family	2.35	2.14	2.69	2.60	**2.32**
Above 59	43	61	31	4	**139**
Size of family	2.60	2.77	2.48	4.00	**2.70**
No. of families	211	264	101	21	597
Av. size of families.	**2.11** ±*.11*	**2.22** ±*.07*	**2.30** ±*.13*	**2.76** ±*.29*	**2.22** ±*.06*

ever, may be due to the decreasing size of family, the older scientific men having larger families and coming from families which were larger because they were earlier. The inheritance of physiological fertility would depend partly and perhaps chiefly on the female, and the size of the modern small family is determined in the main by social and psychological causes. If the data here given were valid, they would show a slight correlation of fecundity in successive generations and a slight selective death rate against the larger family, which about balance each other. These conditions are those which must obtain in a state of nature, for unless there is a change in the environment, the number of individuals of a species can not considerably increase, and if they regularly decrease it will be exterminated. The relations which obtain in the families of scientific men are, however, probably due entirely to the decreasing death rates and birth rates of the past seventy-five years.

In Table XIX. the scientific men are divided into four groups in accordance with their distinction and the size of the family from which they came and which they have is given for each degree of distinction. The most distinguished group (I. in the table) came from families of the average size of 4.7 and have families of the average size of 2.5, in both cases above the average. The eminent man is slightly more likely to have more brothers and sisters and appreciably more likely to have more children than his colleagues. The most eminent group is, however, about five years older than the others, and this about accounts for their larger families, so rapid has been the decline in the birth rate. The lack of correlation between the distinction of a scientific man and the size of his parents' family may be due to a combination of causes. On the one hand, the only child or the child from a small family may be more likely to have educational opportunities or inherited wealth; on the other hand, he may have inferior heredity and opportunity for forming character.

TABLE XIX. THE STANDING OF SCIENTIFIC MEN AND THE SIZE OF FAMILY

	I	II	III	IV	Tot. or Av.
Parents' family					**904**
No. of families	71	162	530	141	**4.64**
Average size...	4.73	4.59	4.69	4.45	
Own family					**554**
No. of families	49	111	298	96	**2.22**
Average size...	2.50	2.17	2.14	2.39	

The conditions are similar for scientific men who are unmarried or who have no children or but one, as compared with scientific men with larger families. There is but slight difference in their performance. The similarity may be due to a balance of various conditions, and is also in part accounted for by the fact that men marrying at the average age of 29.5 years have in large measure had such original ideas as they may hope to have and have in the main determined their careers. As a matter of fact those who are unmarried furnish fewer men than the average to the two more distinguished groups while those with six or more children supply a larger number. If the figures for scientific men with the largest families could be regarded as valid, it would be indicated that they are the ablest and most successful, but at the same time furnish the largest share to the group who have dropped out of the first thousand, perhaps owing to the circumstance that scientific work must be neglected to support the children. But the differences are too small and the families are too few to permit any conclusions except that under existing conditions there is no appreciable correlation between the distinction of a scientific man and the size of family from which he comes or which he has. This fact itself is, however, of considerable social significance. The material handicap of the larger family is balanced by improved character and greater efforts or by the superior quality of the men coming from and supporting the larger family. In his study of "Heredity in Royalty" F. A. Woods finds that there is a direct correlation between intellectual and moral qualities and between moral qualities and size of surviving family. In this case the larger family is not a burden for the parents. It is reasonable to assume that if the cost of children could be borne by society for whose benefit they exist, there would be larger numbers of children having superior inherited ability.